JEL: Q10, Q12, Q18

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RATIONALITY OF SOYBEAN FARMERS: THE FINDINGS FROM RAINFED FIELD AGROECOSYSTEMS

Purpose. *This research aims to examine the factors that influence the rationality and income of soybean farmers, especially in rain fed field agroecosystems.*

Methodology / approach. *The research was designed quantitatively with a type of survey on 263 soybean farmers from a total population of 768 farmers spread across Jatiwaras and Pancatengah subdistricts, Tasikmalaya Regency, which is one of the centres for soybean development in West Java, Indonesia. The determination of the farmer sample was carried out proportionally randomly using the Slovin formula with an error rate of 5 %. The data analysed is primary data obtained directly from farmers using a questionnaire with a Likert scale consisting of 5 answer choices. The analytical tool used is Structural Equation Model (SEM) with AMOS to determine the influence between variables.*

Results. *The research results show that: (1) Farmer characteristics have a significant positive relationship with farmer motivation. These characteristics are a strong driving force to increase their motivation in soybean farming to be even better in an effort to increase their income; (2) Farmer characteristics have a significant positive effect on farmer rationality. The older the age, the higher the education, and the greater the burden of responsibility borne by the farmers' family, the more rational they consider soybean cultivation to be, which means that they will be more cautious in growing soybeans to minimise the risk of losses they may incur; (3) Farmer motivation has a significant positive effect on farmer rationality. The stronger farmers' motivation in soybeans farming, the more rational it makes them in thinking about farming as well as possible; (4) Farmer rationality has a significant positive effect on income. The more rational the thinking of farmers in soybean farming, in the sense that they can effectively use social networks, efficiently grow soybeans and adopt technology, the more they can increase production, which ultimately increases income.*

Originality / scientific novelty. *This study focuses more on the rationality of smallholder farmers in Indonesia, who have many structural disadvantages, such as limited land ownership, average age of farmers, low education level and many family responsibilities, which are constraints to soybean farming; how smallholder farmers are related to motivation in soybean farming and whether this farmers' rationality can increase their income, while several previous studies only discussed farmers' rationality without considering socioeconomic factors, especially smallholder farmers.*

Practical value / implications. *This research provides evidence that there is a relationship between farmer characteristics and motivation which has a significant effect on farmer rationality so that in the end it can increase income. The results of this research have implications for government policies in efforts to increase farmers' income by increasing their capacity through intensive and sustainable agricultural extension activities. The existence of more intensive and sustainable agricultural extension activities can increase the knowledge and insight of small farmers in soybean*

farming, which in turn can motivate farmers to think and act more rationally so that they can better optimise all the resources they have.

Key words: *agroecosystem, farmer rationality, income, soybean, Indonesia.*

1. INTRODUCTION

Small farmers, especially in developing countries, are a group of poor people in rural areas who are faced with the problem of income uncertainty, one of which is caused by climate change (Hu et al., 2019; Khanal et al., 2018; Tang, 2019; Thiede & Gray, 2017). Climate change not only poses a risk to food security as a result of water shortages in the dry season and excess water in the rainy season, but can further impact the welfare of society, especially small farmers who have limited land ownership and low education (Suryanto et al., 2020; Yusuf et al., 2021).

Soybeans are one of the many types of plants cultivated as a provider of staple foodstuffs as well as a source of protein (Zhang et al., 2020). Apart from being needed by the food industry, soybeans are also needed by the animal feed industry. As a food source, soybeans act as a very important source of vegetable protein for improving human nutrition, because in addition to being safe for health, it is also relatively cheap compared to animal sources of protein (Park et al., 2023; Sayaka et al., 2021; Shea et al., 2020; Xiaoming & Qiong, 2018).

The demand for soybeans in Indonesia continues to grow along with population growth and the need for industrial raw materials for food processing, such as tofu, tempeh, soy sauce, soy milk, tauko, snacks, etc. In 2020, the average consumption of soybeans was around 11–12 kg per capita/year (Harsono et al., 2022; Sayaka et al., 2021). According to BPS (2019, 2020), soybean production in Indonesia is only 982,598 tons, which is not comparable to domestic demand which reaches 3.6 million tons, so it is necessary to import 2.6 million tons, this is more due to the low productivity of soybeans at the farmer level, which is the average over the last 10 years (2010–2020) only reached 1.50–1.54 tons per hectare. According to Harsono et al. (2022), Shea et al. (2020), Xiaoming & Qiong (2018), the low productivity of soybeans is caused by: a) high competition for land use; b) low stability of crop yields because soybeans are very susceptible to pests and disease attacks; c) efforts to expand planting areas have not been successful; d) low quality of seeds used; e) the soybean trading system is less conducive; f) less intensive cultivation techniques, and g) low profits from soybean farming compared to other crop farming. This performance was not achieved as a result of the use of production facilities that do not meet the recommendations. This huge productivity gap provides an opportunity to increase production by increasing productivity at the farm level (Didorenko et al., 2021; Yanuarti et al., 2019).

However, when the income farmers receive is not commensurate with the losses they incur, farmers will not want to farm (Burns & Roszkowska, 2016). According to Li & Guo (2017), there are three basic elements of decision making based on human behaviour, namely: a) bounded rationality; b) limited willpower; c) limited personal interests. The concept of bounded rationality implies that actors assumes that actors seek

to maximise utility, whereas the notion of bounded self-interest means that they not only pursue economic interests, but also pay attention to fairness and trust. Therefore, farmers' behavioural decisions will be influenced by social interactions with other farmers, resulting in group behaviour that is not entirely selfish (Wang et al., 2021).

Soybeans can be grown in almost all agroecosystems, both in rice paddies and on land, one of which is West Java, which is one of the soybean development areas in Indonesia. According to BPS (2019), the agroecosystem conditions on the island of Java are indeed favourable for soybean development in Indonesia, as evidenced by the potential of 3.8 million hectares of rice fields and 2.6 million hectares of land. On irrigated paddy fields, soybeans can be planted using a paddy-soybean planting system, and a paddy-soybean planting system on non-irrigated paddy fields (Harsono et al. 2022; Xiaoming & Qiong, 2018). The main obstacle to cultivating soybeans on optimal land is competition with other commodities that have more land, economic value, especially corn (Sayaka et al., 2021; Seok et al., 2018).

One of the soybean development areas in Indonesia is Tasikmalaya Regency, West Java Province. Soybean production in Tasikmalaya Regency from 2011–2015 has increased by 131 %, from 2,807 tons in 2011 to 6,476 tons in 2015, with an average annual increase of 38 %. In addition, the average productivity is high, even some sub-districts with soybean production centres have higher productivity than the productivity of West Java Province and nationally. The average soybean productivity in West Java is 1.63 tons per hectare, while the national average soybean productivity is 1.56 tons per hectare (BPS, 2020). The high increase in production and productivity shows that Tasikmalaya Regency has the potential for developing a large and sustainable soybean agribusiness to contribute to the national soybean self-sufficiency program. With limited land and water resources, have farmers in Tasikmalaya province been sustainable in their soybean production, and can farmers' rationality increase their incomes? This research aims to examine the factors that influence rationality and income of soybean farmers, especially in rain fed field agroecosystems.

2. LITERATURE REVIEW

Soybean productivity is locally specific, determined by the agroecological characteristics of the planting area. Didorenko et al. (2021), Shea et al. (2020), Xiaoming & Qiong (2018), state that soybean productivity is generally influenced by the use of superior soybean varieties and the application of soybean cultivation technology in accordance with recommendations or suggestions. Specific land conditions have consequences that demand rational actions by farmers in managing the right timing of planting and harvesting. This is necessary because planting and harvesting time planning can be a determinant of the success of farming. Ali et al. (2020), Cordaro & Desdoigts (2021), Hu et al. (2019), Yusuf et al. (2021) stated that in farming activities, it is often found that many farmers carry out farming activities based on habit and experience alone, so that rationality is often ignored. This can be caused by the existence of several problems among farmers, such as limited capital and the difficulty of obtaining production facilities that influence farmers in making

decisions. Therefore, the rationality of farmers is needed in doing farming as an effort to obtain maximum profits. This is in line with Bros et al. (2019), Wang et al. (2022) that while profit is an important factor, it is not only thing that drives farmers to make decisions in economic context. Apart from economic factors, there are also non-economic factors that encourage farmers to make decisions, especially in relation to other farmers and their opinions regarding the use of technology in the farming they do (Ali et al., 2020; Balogh et al., 2020; Le Coent et al., 2018; Liu & Wu, 2015). Social norms are rules of behaviour that are supported by a combination of empirical and normative expectations (Thogersen, 2014; Thomas et al., 2019). According to Le Coent et al. (2018), Vortkamp & Hilker (2023), in practice, there are some farmers who are very reluctant to apply new technology in running their farming business even though it can theoretically increase their income.

With the limited availability of land and water, namely rain-fed lowland paddy fields, farmers will usually consider their decision to carry out soybean farming more by prioritising rationality, which aims to obtain higher income with the technology they have mastered. According to Harsono et al. (2022), soybean productivity in Indonesia using farmer technology is still relatively low, ranging from 1.5–1.8 tonnes per hectare, even though if farmers use advanced technology the potential productivity that can be achieved in the lowlands is 3 tonnes per hectare. The rationality of a farmer is not entirely related to maximising the economy in his/her farming business, but also considering the social (cultural) and environmental benefits of his/her decision making to carry out soybean farming (Cordaro & Desdoigts, 2021; Hu et al., 2019; Sayaka et al., 2021; Shea et al., 2020). Setiawan (2012) emphasised that farmers actually always adapt to the environment in which they live and are always creative in coming up with new ideas through local competence (wisdom). The diversity of knowledge, technological competence and local resources is a fact of the empowerment of the founders and generations of farmers. Based on the search for previous research results, the following hypothesis can be formulated:

H1: Farmer characteristics have a positive correlation and significance on farmer motivation.

The characteristics of farmers are many and varied, but the most important are age, education and family responsibilities (Balogh et al., 2020; Bedi et al., 2020; Seok et al., 2018). Age is related to motivation, this means that the more productive the age, the stronger the motivation of farmers to run a business and adopt a technology. According to Maican et al. (2021), Bedi et al. (2020), Switek & Sawinska (2017), farmers' motivation for farming not only includes meeting the living needs of farmers, but is also related to increasing the need for agricultural production facilities and infrastructure. Likewise, with education: the higher a person's level of education causes greater insight and knowledge so that access to obtain something will be more open (Ozdemir et al., 2021; Widhiningsih, 2020). The growing number of family responsibilities means that farmers' life burdens are becoming more numerous and diverse, which of course requires farmers to work harder to meet basic needs of their families (Demartini et al., 2017).

H2: Farmer characteristics have a positive effect and significance on farmer rationality.

In a sociological approach, age plays an important role in determining a decision, this is more because age determines a person's level of maturity (Hu et al., 2019). Mature farmers tend to think more rationally than younger farmers. In making decisions, farmers with higher education tend to be more careful by considering the various risks they may face (Cordaro & Desdoigts, 2021; Domeier et al., 2018; Switek & Sawinska, 2017).

H3: Farmer motivation have a positive effect and significance on farmer rationality.

Usually farmers are motivated to cultivate a type of plant if the plant has a low risk but can provide added value for farmers (Yusuf et al., 2021). Motivation itself is an impulse from within as a result of a need, both economic and non-economic, which can be fulfilled through rational thinking (Balogh et al., 2020; Cordaro & Desdoigts, 2021; Hu et al., 2019). Cordaro & Desdoigts (2021) stated that farmers will adopt a technology after going through stages of rational thinking that can be profitable.

H4: Farmer rationality have a positive effect and significance on farmer income.

Farmers' rationality is very important so that they can adopt technology in the agricultural sector. Farmers who think rationally will be easier to persuade to abandon old conventional methods and replace them with new technology that can increase income (Cordaro & Desdoigts, 2021; Hu et al., 2019). Several studies show that farmers who are younger and more advanced in thinking can run businesses better (Ali et al., 2020; Boyabatli et al., 2019; Switek & Sawinska, 2017).

3. METHODOLOGY

The study was conducted through a quantitative survey of 263 on-farm soybean farmers out of a total of 768 farmers in Jativaras and Pankatenga sub-districts, Tasikmalaya. The research location was determined deliberately with the consideration that it is one of the soybean development areas in Indonesia. The sample of farmers was determined randomly using the Slovin's formula with an error rate of 5 %, which was determined proportionally.

The data used in this study consisted of primary data and secondary data. Primary data is data collected directly from soybean farmers through questionnaire interviews and focus group discussions (FGDs). Meanwhile, secondary data was obtained from related offices and agencies, journals, books and other data sources.

Data processing and analysis were performed using descriptive statistics and inferential statistics with multiple linear regressions to determine the functional relationship between variables. The multiple linear regression equation models in this study are as follows:

$$Model\ 1: Y_1 = \beta_1 X_1 + \beta_2 X_2 + e, \quad (1)$$

$$Model\ 2: Y_2 = \beta_1 Y_1 + e, \quad (2)$$

where Y_1 – farmers' rationality;

Y_2 – farmers' income;

β_1, β_2 – coefficient of regression;
X_1 – farmers' characteristic;
X_2 – farmers' motivation;
e – error.

The analysis tool used Structural Equation Model (SEM) with the AMOS program version 18.0. SEM is a multivariate statistical technique combining factor analysis and regression (correlation) analysis, which aims to examine the relationship between variables in a model, both indicators and constructs, or relationships between constructs. The structural equation model would produce indicators that support the proposed model. Hair et al. (2010) write that there are 7 (seven) stages of structural equation model and analysis: (1) theoretical model development; (2) compiling a path diagram; (3) converting the path diagram into a structural equation; (4) selecting an input matrix for data analysis; (5) assess model identification; (6) evaluate the model estimation, and; (7) interpretation of the model as can be seen in Figure 1.

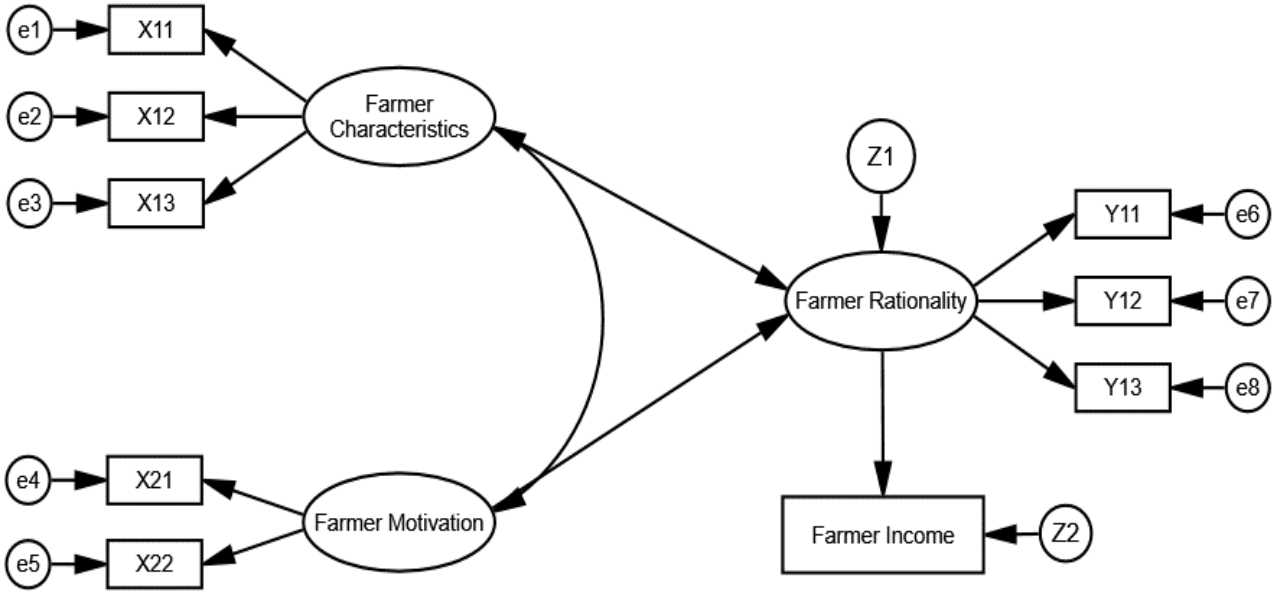

Figure 1. Research method design

Source: AMOS output.

Figure 1 showed that rationality (Y_1) as an endogenous latent variable as measured by indicators social rationality (Y_{11}), economic rationality (Y_{12}), and technological rationality (Y_{13}) meanwhile income (Y_2) as manifest variable. This endogenous latent variable is influenced by exogenous latent variables. The exogenous latent variables included the characteristics of farmers (X_1) as measured by indicators age (X_{11}), education (X_{12}), and family depends (X_{13}). The exogenous latent variables of motivation (X_2) were measured by the indicators intrinsic motivation (X_{21}) and extrinsic motivation (X_{22}). Both of variable endogenous and exogenous involved in latent variable are correlated with each other, therefore, the proper analysis tool is SEM.

The test type is two tailed: positive and negative area of hypothesis. In more detail, the latent variables and indicators can be seen in Table 1.

Table 1

The variables and indicators in model

Latent and Manifest Variable	Indicators	Scale
Farmer characteristics (X_1)	Age	1. Low; 2. Medium; 3. High
	Education	1. Low; 2. Medium; 3. High
	Family dependents	1. Low; 2. Medium; 3. High
Farmer motivation (X_2)	Intrinsic motivation	1. Low; 2. Medium; 3. High
	Extrinsic motivation	1. Low; 2. Medium; 3. High
Farmer rationality (Y_1)	Social rationality	1. Low; 2. Medium; 3. High
	Economic rationality	1. Low; 2. Medium; 3. High
	Technological rationality	1. Low; 2. Medium; 3. High
Farmer income (Y_2)	Income obtained from soybean farming	1. Low; 2. Medium; 3. High

Source: authors' development.

The variables studied in this study were farmer characteristics, farmer motivation, farmer rationality, and income, measured through question items with a 5-point Likert Scale. The method of data analysis used in this study uses descriptive analysis.

4. RESULTS

4.1. Farmers' characteristics. The farmers' characteristics that are central to this study include age, education level, experience and family (Table 2).

Table 2

Characteristics of soybean farmers' in Tasikmalaya, Indonesia

Description		Number, person	Percentage, %
1	Age (year)		
	a. 15–64	227	86.3
	b. ≥ 65	36	13.7
Total		263	100.0
2	Education level		
	a. Elementary	215	81.7
	b. Junior	46	17.5
	c. Senior	2	0.8
Total		263	100.0
3	Experience (year)		
	a. 5–20	143	54.4
	b. 21–35	112	42.6
	c. 36–50	8	3.0
Total		263	100.0
4	Family dependents (person)		
	a. 1–3	221	84.0
	b. 4–6	42	16.0
Total		263	100

Source: results of primary data processing (2023).

The results of the survey show that farmers' ages range from 23 to 71 years old, with an average age of 49 years old, so they are in the span of a productive period. Age is one of the factors related to work ability in carrying out farming activities (BPS,

2021; Yusuf & Yulianeu, 2023). Farmers with low levels of formal education predominated among the respondents. This is consistent with the view of Yusuf et al. (2021) that education is one of the factors that facilitate farming, meaning that the higher the education a farmer has, the more knowledge and understanding he/ she will have. This problem has led to the ability to manage lowland rice farming at optimal productivity. Education is linked to their access to food, as higher education increases opportunities for better jobs with higher incomes (Odoh et al., 2019).

The land area of farmers ranges from 0.02 to 0.98 hectares with an average of 0.15 hectares, which is in the narrow category with the most dominating amount; while Danso et al. (2020) and Davis et al. (2017) argue that land is an asset for farmers in their business that will determine their income, standard of living and well-being. The most dominating are farmers who cultivate soybeans with a relatively narrow land area, and most of them are rainfed lowland paddy fields and even then they are not all soybean planted. Meanwhile, land belonging to a large soybean group is owned by a farming group run by one of the group's members. This condition indicates that the structural weakness of small farmers in rural areas, which in general is narrow land tenure, is still very much related to the study area. This causes unequal income earned and the production produced by farmers. For farmers with small plots of land, the income they receive is also low. According to Firdaus et al. (2020), Khanal et al. (2018), Tang (2019), Yusuf et al. (2021), the narrow ownership of land held by farmers results in them being trapped in a survival situation, which means that the farming business they run is only sufficient to survive.

The experience of farmers in soybean farming also varies; the range is from 5 to 50 years, with an average of 27 years. Experience is the knowledge that people gather with the help of their minds and then organise it into certain forms. A person's experience in farming influences the response in accepting new technologies and innovations (Ntshangase et al., 2018; Shea et al., 2020; Xiaoming & Qiong, 2018). The experience of growing soybeans that farmers have is very useful for running a farm for profit.

The number of dependents in a family ranged from 1 to 6 people, with an average of 2 dependents per family. The small number dependents of farming families illustrated those small families in rural areas as the main view of farmers' family members. Thus, it is also related to the proverb of the agrarian society's Javanese culture, assuming that "many children, many fortunes" is still believed. Even in fact, the more the number of family members, the greater the burden of living that must be borne by farmers. According to Davis et al. (2017), Ndhleve et al. (2021), Ruhyana et al. (2020), Xiaoming & Qiong (2018), family size will affect the income per capita and household food consumption expenditure.

4.2. Formulation of the model. To determine the indicators used in the model, Confirmatory Factor Analysis (CFA) was used. From the CFA test, the expected loading factor of each indicator was > 0.5; however, the results showed that there was no indicator that the value of loading factor was less than 0.5. Therefore, all indicators in the model could be used to predict the variable (Table 3).

Table 3

Convergent validity

Variables			Factor Loading	P	Note
X_{11}	---->	Farmer characteristics	0.889	***	Significant
X_{12}	---->	Farmer characteristics	0.898	***	Significant
X_{13}	---->	Farmer characteristics	0.953	***	Significant
X_{21}	---->	Farmer motivation	0.975	***	Significant
X_{22}	---->	Farmer motivation	0.803	***	Significant
Y_{11}	---->	Farmer rationality	0.845	***	Significant
Y_{12}	---->	Farmer rationality	0.890	***	Significant
Y_{13}	---->	Farmer rationality	0.797	***	Significant

Note. *** Significant at level 0.001.
Source: authors' computation (2023).

Table 3 shows that all the indicators used are valid in terms of the loading factor value > 0.5. To test the validity and reliability of exogenous and endogenous latent constructs, Construct Reliability (CR) and Average Variance Extracted (AVE) were used (Table 4). According to Hair et al. (2010), the construct has good reliability if the value of CR ≥ 0.70 and AVE ≥ 0.50.

Table 4

Validity and reliability construct

Variables	Construct Reliability	Average Variance Extracted
	CR > 70 %	AVE > 50 %
Farmer characteristics	72.28	84.70
Farmer motivation	72.60	81.46
Farmer rationality	73.61	74.68

Source: authors' computation (2023).

The Table 4 shows good construct validity and reliability for the sample measurement model. The value of construct reliability is greater than 0.7, the convergent validity value ranges from 0.74 to 0.84, while the value of the validity extracted was more significant than 0.5. The results proved the convergent validity by examining the significance of the loadings factor and the shared variance. The variance captured by the construct should be greater than the measurement error (0.5). The formed structural equation explained the causal relationship between changes in income and changes in farmers' characteristics, motivation and rationality.

The results of SEM assumptions and data processing to test the hypothesis consisting of a multivariate outlier test, multivariate normality test, and multicollinearity test all meet the required assumptions. After fulfilling all the test assumptions, it can be concluded that the output of the AMOS model, the SEM model and the farmers' rationality in Tasikmalai is obtained, as shown in Figure 2.

The Figure 2 shows that farmer characteristics are related to motivation and affect farmer rationality, which ultimately affects income. This condition was reasonable considering that the average age of farmers is in the productive age range. It could work more optimally because it would be supported by adequate physical strength. Therefore, they could access other sources of income outside of soybean farming.

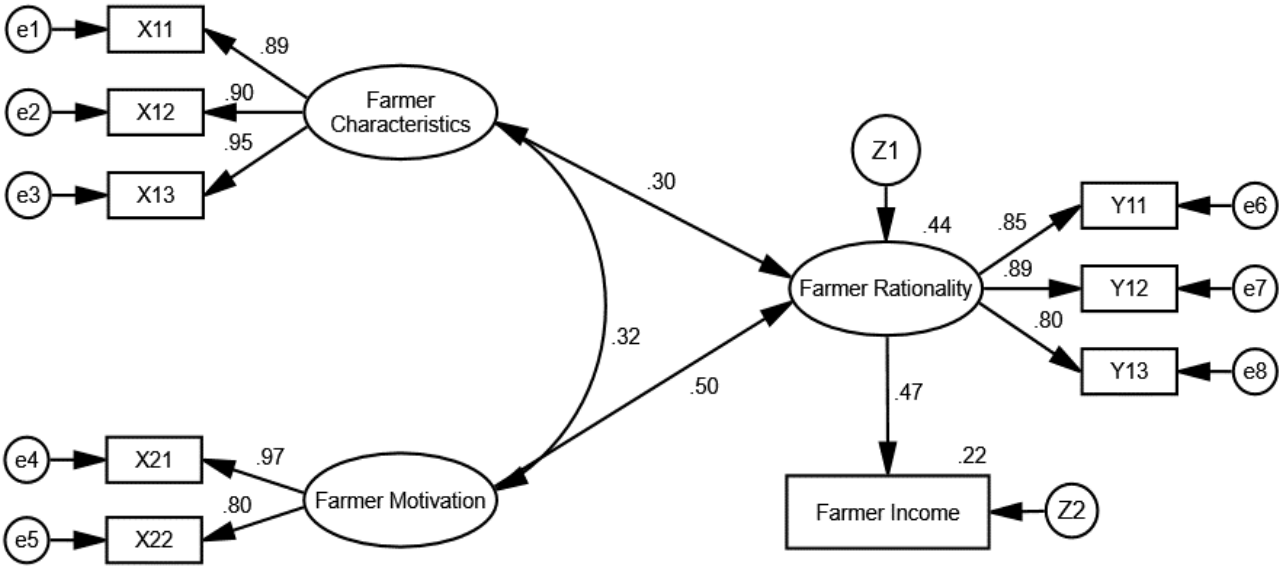

Figure 2. Results of SEM model analysis of farmer rationality in rainfed field agroecosystems

Source: AMOS output.

To test the accuracy of the model, model Fit Index was used and the results is presented in Table 5.

Table 5

Feasibility test results of full model SEM

The goodness of Fit Index	Cut-off Value	Result	Conclusion
Chi-Square	Expected small	61.461	Fit
Significance Probability	≥ 0.05	0.068	Fit
RMSEA	≤ 0.08	0.077	Fit
GFI	≥ 0.90	0.952	Fit
AGFI	≥ 0.90	0.909	Fit
CMIN/DF	≤ 2.00	1.803	Fit
TLI	≥ 0.90	0.978	Fit
CFI	≥ 0.50	0.984	Fit
NFI	≥ 0.90	0.962	Fit

Source: authors' computation (2023).

Table 5 showed a good model Fit Index, GFI, AGFI, TLI, NFI > 0.90, CFI > 0.95, CMIN/DF < 2, RMSEA < 0.08, significance probability > 0.05, and chi-square small, meaning that the model fits the data. Regression estimation for SEM shows that all variables are significant (Table 6), so all hypotheses are accepted.

Table 6

Regression estimate

Variables			b	SE	CR	P	Note
Farmer characteristics	<--->	Farmer motivation	0.319	0.058	3.413	***	Significant
Farmer characteristics	---->	Farmer rationality	0.305	0.060	5.209	***	Significant
Farmer motivation	---->	Farmer rationality	0.501	0.081	7.928	***	Significant
Farmer rationality	---->	Income	0.470	0.079	7.679	***	Significant

Note. *** Significant at level 0.001.

Source: authors' computation (2023).

Thus, on the basis of Table 6, we can form a structural equation of the exogenous latent variable to the endogenous latent variable, which looks like this:

$$Y_1 = 0.305\ X_1 + 0.501\ X_2 + e, \quad (3)$$

$$Y_2 = 0.470\ Y_1 + e. \quad (4)$$

The calculation results showed that simultaneous influence farmer rationality was explained by farmer characteristics and farmers motivation of 44.2 %. The remaining 55.8 % is explained by other factors not included in the structural equation model. The factor that has the strongest influence on farmer rationality is reflected by social rationality (λ = 0.85), economic rationality (λ = 0.89), and technological rationality (λ = 0.80) is farmer motivation, which is reflected by intrinsic motivation (λ = 0.97) and extrinsic motivation (λ = 0.80). Meanwhile income of farmers was explained by farmer rationality 22.1 % and the remaining 87.9 % is explained by other factors not include in the structural equation model. The factor that has the greatest impact on farmers' incomes is farmers' rationality, which is reflected through economic rationality (λ = 0.89), social rationality (λ = 0.85), and technological rationality (λ = 0.80) is a strong shaper the latent variable of farmer motivation. Thus, intrinsic motivation and extrinsic motivation have the greatest potential contribute to farmer motivation.

The smallholder farmers are generally interested in growing soybeans because they hope to earn higher profits than the rice they normally grow, as the soybeans they grow are a catch crop when rice fields are not planted with rice during the dry season due to water shortages. For them, planting soybeans can replace lost income from paddy farming during the dry season. This is in line with Murithi et al. (2016), Sinclair et al. (2014), Yusuf et al. (2021), since of the efforts made by small farmers to minimise risk is to plant crops that have economic value but are resistant to water shortages in addition to having a dual function to fertilise the soil. For them, planting soybeans can replace lost income from paddy farming during the dry season.

The rational response of farmers in soybean farming activities can be seen in their actions in various resource decisions and activities in the production process. According to Cordaro & Desdoigts (2021), Hu et al. (2019), this is based on traditional actions, namely habit-based actions, which are carried out when choices are determined by familiarity, which has been ingrained in farmers from generation to generation. Socially, farmers can still interact with other farmers during harvesting, which typically involves many people whose results are then distributed according to what they have produced.

The decisions making by farmers are inseparable from the motivation of the farmers themselves, but of course all are based on the rational actions of farmers. Güss & Robinson (2014), Yusuf & Yulianeu (2023) call it intrinsic motivation and extrinsic motivation. Soybean cultivation, carried out by farmers in rainfed rice fields, is an alternative that allows them to generate income even when their land is not planted with rice. This is in line with Domeier et al. (2018), Güss et al. (2017), that motivation plays a very important role in solving very complex problems, which can ultimately determine the solution. Thus, the decision of farmers in cultivating soybeans in rainfed

paddy fields is more due to the motivation to earn income so that economic rationality is more dominant than social rationality and technological rationality.

5. DISCUSSION

The results of the SEM analysis show that the coefficient value of the influence of farmer motivation is positive, meaning that the higher the farmer's motivation, which is reflected by the higher the intrinsic and extrinsic motivation, the higher the farmer's rationality. Intrinsic motivation is motivation that comes from within oneself, which usually arises without any external influence. Usually people who are intrinsically motivated are more easily motivated to take action even though they can motivate themselves without needing to be motivated by others (Burns, 2021; Demartini et al., 2017). The availability of land makes farmers motivated from within themselves to plant soybeans; soybeans farmers experience enormous benefits from this activity, both economic and social benefits. However, income from soybean farming cannot be used as the main source of income to meet the needs of farmer households.

Extrinsic motivation is motivation or encouragement that arises from the outside or other people. Demartini et al. (2017), Maican et al. (2021), Ozdemir et al. (2021) stated that those who motivate or motivated by extrinsic motivation are people who can encourage, attract, involve or stimulate others to take action. Extrinsic motivation has the power to change a person's will. Someone can change their mind from not wanting to be willing to do something because of this motivation (Burns, 2021; Widhiningsih, 2020; Yusuf & Yulianeu, 2023). The existence of government soybean assistance or programs has made farmers in Tasikmalaya Regency more motivated to plant soybeans; farmers feel helped in terms of providing inputs provided by the government to support soybean farming activities. In addition, with the support of an agronomist-instructor, the school helps farmers apply the recommended technologies through consultations and visits to soybean fields. However, soybean farmers have hopes for this government assistance to be sustainable, both in terms of meeting the farmers' needs and the timely delivery of assistance.

5.1. Relationship between farmers' characteristics and farmers' motivation. Farmer characteristics are positively related to farmer motivation, meaning that the higher the farmer characteristics, which are reflected in the more productive age of farmers, higher education level of farmers and more family members, the higher the motivation of farmers to grow soybeans. Motivation is an impulse that arises both from within and from outside the individual, which is called intrinsic motivation and extrinsic motivation to carry out a certain activity (Yusuf & Yulianeu, 2023). The motivation of farmers in soybean farming is to make a profit when they do not plant the main crop commodity, namely paddy, due to lack of water in the dry season. Soybean farming is an activity that has been carried out for generations with a relatively easy planting process with a low risk of failure and does not require too much water.

The research results reveal that farmers who have more family responsibilities and are older tend to be more motivated to cultivate soybeans when there is a water

shortage. Farmers argue that according to their experience, soybeans are very suitable for planting when not planting paddy during the dry season because this plant does not require a lot of water. This is in line with Murithi et al. (2016), Shea et al. (2020), Sinclair et al. (2014), Wijanarko & Taufiq (2016), who note that soybeans can still grow well in conditions of lack of water so they can be used as intercrops if the main crop which requires a lot of water is not planted by farmers. In this way, farmers will still earn income even though their main source of income, namely paddy farming, is not planted because they get other sources from soybean farming.

There is no denying that the goal of farmers in agriculture is to make a profit. Farmers will be more motivated to plant crop if the commodity is profitable for them. Soybean farming carried out by farmers in the research area is one strategy to obtain income when their main farming business, namely paddy, is not planted as a result of a lack of water supply. Interviews with farmers revealed that this is one of the components of crop rotation. According to Waha et al. (2018, 2020), Wu et al. (2018), farmers realise that if their land is continuously planted with one commodity, it can result in low productivity as well as an uninterrupted pest cycle.

Research result of Balogh et al. (2020) shows that farmers in Hungary who are more productive and have higher education tend to be more motivated to carry out precision agriculture in the hope of obtaining higher production. Likewise, with the research results of Bedi et al. (2020) in Northern Ghana, farmers who have many family responsibilities are more motivated to run better farming businesses due to a stronger economic incentive to be able to earn income in an effort to provide for their families.

5.2. The influence of farmers' characteristics on farmers' rationality. The influence of farmer characteristics on farmer rationality is reflected by age, education and family responsibilities. The number of family dependents is the indicator that most strongly reflects farmer characteristics ($\lambda = 0.95$), education ($\lambda = 0.90$), and age ($\lambda = 0.89$) so that the influence of the number of family dependents, education and age has the greatest potential for improving farmer characteristics.

If we look at the regression coefficient, which has a positive sign, this means that the higher the farmer's characteristics, which are reflected in more family responsibilities, higher education and a more productive age, the more rational the farmer is. This is normal, given that the evidence on the ground shows that the average farmer is in a productive age that allows him/her to think more rationally about soybean farming. The more productive age of farmers means that their mindset is more open, so they do not find it difficult to accept new ideas and technologies to succeed in their farms, and the improved quality of farm families means that the burden of farmers' lives is reduced (Bahta et al., 2017; Zeweld et al., 2017). Family dependents reflect the large number of needs, both food and non-food, that must be provided by farmers, so that the greater the number of family dependents, the more rational farmers will be in soybean farming. This means that farmers will become more serious about pursuing soybean farming in the hope that the income they earn will be greater, which will ultimately be able to meet their family's needs (Liu & Wu, 2015; Thomas et al., 2019). Income is an estimator for household purchasing power.

Another farmer characteristic that reflects farmer rationality is education and age. The research results show that highly educated farmers think more rationally in cultivating soybeans because education is related to the knowledge they have. Even though the formal education received by farmers is dominated by basic education, in reality they attend non-formal education such as agricultural extension and field schools which are routinely held (Boza et al., 2021; Wulandari, 2015). Continuous non-formal education for farmers can increase farmers' knowledge and insight, which ultimately makes farmers think more rationally about how to use technology, which can ultimately increase their income.

The results of the study show that farmers growing soybeans in the study area acted rationally when growing soybeans, as evidenced by the varieties they grow, which are local varieties adapted to the conditions of the local agroecosystem. Using local varieties is one of the efforts made by farmers to minimise risks (Cordaro & Desdoigts, 2021; Domeier et al., 2018; Hu et al., 2019; Mutea et al., 2019; Switek & Sawinska, 2017). This is in line with Nephawe et al. (2021) that high rainfall and pest and disease attacks can reduce agricultural production.

***5.3. The influence of motivation on farmers' rationality*.** Intrinsic motivation is the indicator that most strongly reflects farmer motivation ($\lambda = 0.97$), followed by extrinsic motivation ($\lambda = 0.80$), so the impact of intrinsic and extrinsic motivation has the greatest potential to increase farmer motivation. Intrinsic motivation is an impulse that comes from a farmer. Decision making does not occur in a vacuum, meaning that needs are influenced by certain characteristics and situations (Domeier et al., 2018; Yusuf & Yulianeu, 2023). Farmers also look for other options until their needs are met so that the available options are not only assessed based on the potential to achieve goals, but also based on the potential to meet their needs.

The research results show that the motivation of farmers to run soybean farming is a choice to utilise land when they cannot grow other commodities. Farmers' understanding regarding soybean plants is that this plant does not require too much water but is adaptive to agroecosystem conditions in dry land. This is a rational choice for farmers considering the condition of the agroecosystem which is dominated by dry land. Research result of Boyabatli et al. (2019); Zhang et al. (2020) in Africa and China shows that soybeans can achieve high productivity even though water availability is insufficient.

Another motivation for running a soybean farming business is efforts to implement government programs. The government provides seed and fertiliser assistance to farmers who want to run soybean farming. The program being implemented is an effort to reduce the government's dependence on soybean imports because in Indonesia soybeans are one of the important foodstuffs, which are usually processed into other food products, for example tofu which is widely consumed by the public.

5.4. The effect of farmers' rationality on income. Economic rationality is the indicator that most strongly reflects farmers' rationality, as different types of rationality are characterised by the following parameters: economic rationality ($\lambda = 0.89$), social

rationality (λ = 0.85) and technological rationality (λ = 0.80). So that the influence of economic, social and technological rationality has the greatest potential to increase farmers' rationality. The results of the analysis show that the regression coefficient has a positive sign, meaning that the more rational farmers are in cultivating soybeans, which is reflected by the higher economic rationality, social rationality and technological rationality, the higher the farmer's income.

Every farmer will of course always consider the pros and cons of the farming activities he/she carries out. Farmers will cultivate commodities that are profitable and obtain adequate income from their farming. The results of interviews with farmers revealed that the soybean business they run is not a main farming business, so it is not the main source of income. This is what leads to sub-optimal production due to sub-optimal mitigation efforts by farmers to avoid the risk of soybean crop failure. Some farmers try to minimise the risk of losses by harvesting soybeans when they are still young. Based on the work of De Silva & Kawasaki (2018), Suryanto et al. (2020), Junaidi et al. (2022), Shen & Odening (2013), Yusuf et al. (2021), it can be noted that it is a form of adaptation carried out by farmers to minimise the risk of loss or crop failure, which is a form of economic rationality.

Soybean planting in rain-fed lowland paddy fields is usually carried out on land owned by themselves or controlled by farmer groups, and some are planted on Perhutani land and land owned by plantation companies, which are handed over to the community to plant and use, with an agreement not to plant perennial crops and cassava. The company does not demand any fees or rent from the farmers managing the land, but only entrusts the land to be looked after and maintained.

One form of social rationality carried out by soybean farmers at the research location is related to land conditions, agroecosystems that are suitable for developing soybeans, namely rainfed paddy fields, dry land (fields, mixed plantations, and plantations), and abandoned dry land (shrub forests, bushes, and reed/grass fields). Farmers usually use the Grobogan and Anjasmoro varieties, which are adaptive to the conditions of their agroecosystem. Based on the work of Didorenko et al. (2021), Harsono et al. (2022), Park et al. (2023), Sayaka et al. (2021), Shea et al. (2020), Xiaoming & Qiong (2018), Zhang et al. (2020), it should be added that the existential condition of humanity is currently becoming more complex, when the temporality of life faces ecological erosion and thermodynamic conditions of sustainability so that the function of environmental rationality becomes something important.

Farmers sell most of their soybean production to farmer groups, which then resell it to agents who also act as wholesalers. Good quality soybeans will be used for seeds, while medium and low-quality soybeans will be sold to tofu and tempeh producers. Based on this, the income received by soybean farmers ranges from IDR 9,850,000 to IDR 10,478,000 per hectare.

Special attention from the government is needed to ensure that the soybean industry is sustainable and less dependent on imports. This can be implemented through a price policy mechanism that favours farmers, optimising the role of cooperative institutions that can position farmers as price-setters, which in turn will

increase farmers' motivation to grow soybeans profitably.

6. CONCLUSIONS

This paper identifies factors influencing the rationality and income of soybean farmers that have not been widely studied previously. Based on the research results, it can be concluded as follows:

1. Farmer characteristics as reflected by age, education level and family dependents are positive and significant related to farmer motivation as reflected by intrinsic motivation and extrinsic motivation. This shows that the characteristics of farmers are a strong driving force to increase their motivation in soybean farming to be even better in an effort to increase their income.

2. Farmer characteristics as reflected by age, education level and family dependents have a positive and significant effect on farmer rationality as reflected by social rationality, economic rationality, and technological rationality. The older the age, the higher the education, and the greater the burden of responsibility borne by the farmer's family, the more rational he/she considers soybean cultivation to be, which means that he/she will be more cautious in growing soybeans to minimise the risk of losses he may incur.

3. Farmer motivation as reflected by intrinsic motivation and extrinsic motivation has a positive and significant effect on farmer rationality as reflected by social rationality, economic rationality, and technological rationality. This shows that the stronger farmer's motivation in soybeans farming, the more rational it makes them in thinking about farming as well as possible.

4. Farmers' rationality as reflected by social rationality, economic rationality, and technological rationality has a positive and significant effect on farmer income. This shows that more rational the farmers' thinking in soybean farming, in the sense that they can make good use of social networks, soybean farming efficiently, and adopt technology, they can increase production which ultimately increases income.

Based on this, non-formal education of farmers through extension must be carried out more intensively to encourage the motivation of small farmers in soybean farming more efficiently so that they can think more rationally which can ultimately increase their income.

7. LIMITATIONS AND FUTURE RESEARCH

There are several limitations to this study that should be improved by future researchers. The limitations of this research are: (1) only two areas were used as research objects, namely Jatiwaras and Pancatengah subdistricts, so they do not describe the actual situation; (2) the object of research is only focused on farmers who plant soybeans on small amounts of land, even though most farmers plant soybeans in paddy fields during the dry season as an effort to utilise land when water availability is very low; (3) this study does not look at local competence, so further research should identify cultural factors and local competence that were not identified in this study but may influence the rational thinking of small farmers in rural areas.

Funding: this research was funded by Siliwangi University's internal research budget.

Acknowledgments: the authors thank the Rector of Siliwangi University who has fully funded this research.

Conflict of interest: the authors declare no conflict of interest.

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Citation:

Стиль – ДСТУ:

Djuliansah D., Noor T. I., Noormansyah Z., Yusuf M. N. Rationality of soybean farmers: the findings from rainfed field agroecosystems. *Agricultural and Resource Economics*. 2024. Vol. 10. No. 3. Pp. 248–269. https://doi.org/10.51599/are.2024.10.03.10.

Style – APA:

Djuliansah, D., Noor, T. I., Noormansyah, Z., & Yusuf, M. N. (2024). Rationality of soybean farmers: the findings from rainfed field agroecosystems *Agricultural and Resource Economics*, 10(3), 248–269. https://doi.org/10.51599/are.2024.10.03.10.